

Pharmaceuticals and Personal Care Products in the Environment

The Next Environmental Frontier?

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Outline of the Talk

- What are the health and environmental issues
- Efforts to address the issues
- Can and should PPCPs be regulated
- Massachusetts Perspective
- Future

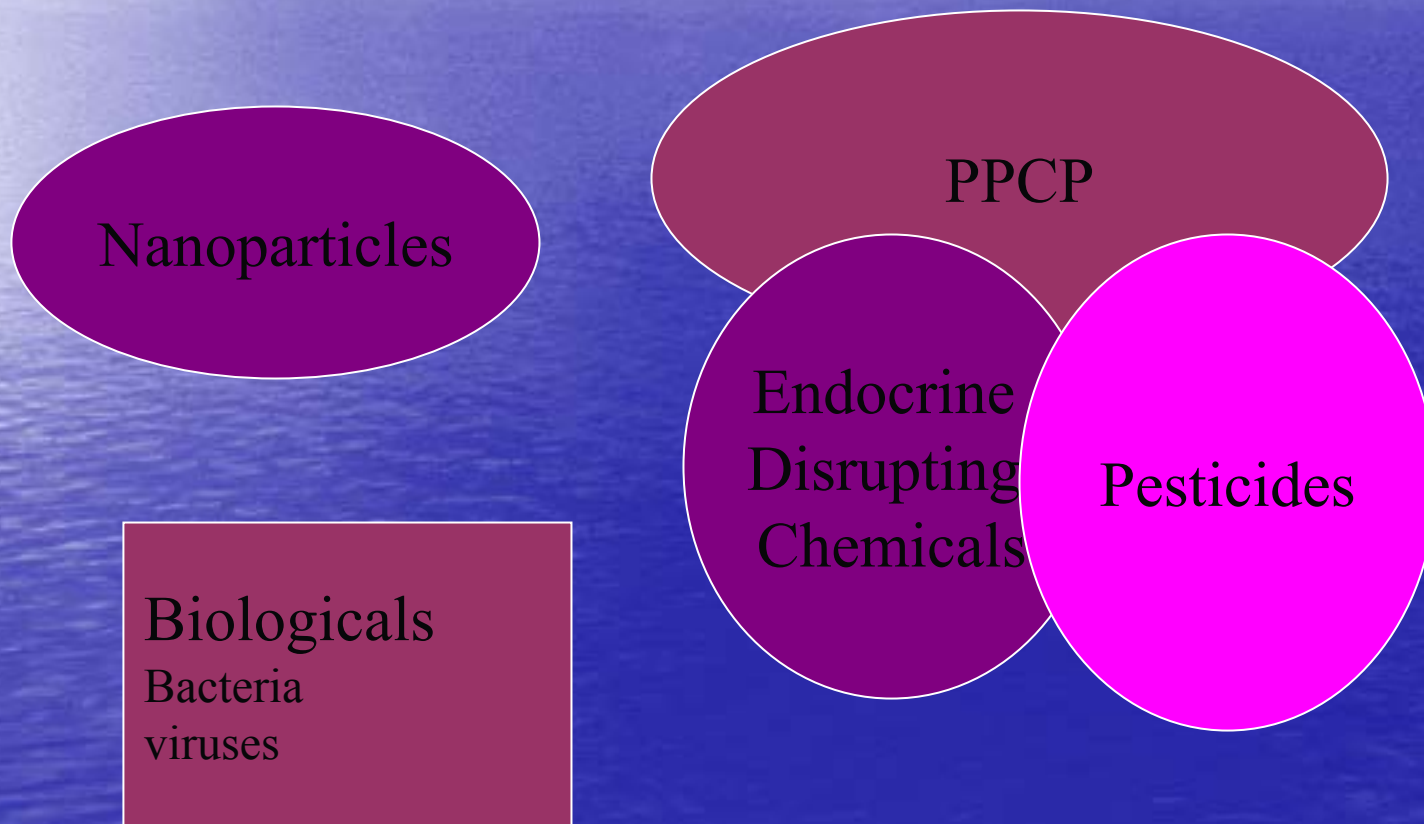
Contaminants of emerging concern

- PPCPs are part of a larger group of issues of emerging concern
 - Nanotechnology
 - Persistent Organic Pollutants (POP)
 - Flame retardants
 - Pesticides and degradates
 - Munitions

Issue of emerging concern

- PPCP have probably been in the environment since first use.
- First investigated in Europe in 1980s
- High public visibility
 - Scientific and popular press
- Unique because of the human health and ecological benefits

Contaminants of emerging concern



PPCP Definitions

- Pharmaceuticals
 - Prescription and OTC
 - Human and veterinary
 - Diagnostic imaging agents
- Nutraceuticals
- Phytochemicals
- Personal care products
 - Fragrances (musks)
 - Detergents and soaps
 - sunscreens

Occurrence In MA

- No comprehensive evaluations
- Detected anecdotally in
 - Surface waters
 - Rivers
 - Lakes
 - Streams
- Wastewater
- Drinking water

Sources of PPCP

- Excretion (~70-90%)
- Disposal (unknown contribution)
- Leaching from landfills
- Runoff from CAFOs
- Wastewater
 - Reuse issues

Fate and Transport

- Most are water soluble therefore move quickly in the environment
- Concern for bioactivity in the environment
- Activity of metabolites
 - Excreted from an organism
 - Metabolized in the environment

Monitoring and Detection

- Analytical methods have become more sensitive, therefore more compounds detected at lower concentrations
- Not everything that can be measured should be measured; not everything that should be measured can be measured
- Need for prioritization strategy

Acute toxicity to humans

- Current evidence seems to indicate a small risk (Schwab *et al.*, 2005, ES/T)
- At the detected concentrations, too much intake required to get a “dose” of the medication
- But we are not treating therapeutically via drinking water!

Toxicity to Aquatic organisms

- They are a captive audience
- The suite of chemicals will be determined by where they are and the contaminant profile of the source(s)
- Pseudopersistence
- Small concentrations of estrogen (17α -ethinylestradiol)
 - Changed sex ration
 - Collapse of the fish population (Kidd *et al.* 2007)

Treatment

- Conventional treatment does not remove PPCPs well
 - Too water soluble (lipophilic)
- Biofiltration may be effective

Pollution Prevention

- Green Chemistry
 - Addressing hazard at its core
 - Designing Safer Chemicals
- Take-back programs
 - Implemented in several states
 - MassDEP is working w MADPH

Preferred Disposal Options

- **DO NOT FLUSH!**
 - FDA may recommend some meds be flushed
- Incineration
- Household waste
 - Make medications unpalatable
 - Remove personal information
 - Keep in original container

Take-Back programs

- Several options available
 - Reverse distributors
 - Return to participating pharmacies
 - Mail back programs
 - Hazardous waste pick up days

Issues for Regulators

- Which compounds of emerging concern are the most hazardous?
- Where are the data
- Risk Communication
 - Calm without alarm
- Water re-use issues
 - “Toilet to tap”
 - “Law of Contagion”

Current efforts to address environmental PPCP

- Regulatory agencies
 - EPA, USGS, FDA, DEA, DPH
 - <http://www.epa.gov/nerlesd1/chemistry/ppcp>
- Education
 - PhARMA
 - Medical community
 - Public
- Sweden's approach
 - Assigning an environmental score for persistence, bioaccumulation and toxicity for each medicine

MassDEP efforts

- Web site
<http://www.mass.gov/dep/toxics/stypes/ppcpedc.htm>
- MassDEP/UMass Amherst/EarthTech project
- USGS/MassDEP Merrimack project
- MassDEP-MADPH cooperative unused medication stewardship effort
- Environmental PPCP Summit:
 - 1 June 5, 2008
 - 2 Spring 2009
- NEIWPC regional PPCP/EC workgroup
- Other outreach initiatives

Challenges for regulating PPCP

- Medicine is essential for maintaining and improving public health
- Most of the toxicology data re generated specifically for clinical studies
 - Not at the levels appropriate for environmental risk assessment
- Significant environmental contribution is unavoidable (excretion)

Future Efforts for PPCPs in MA

- Focus on aquatic issues
- Develop enhanced risk communication strategies and materials
- Unwanted/unused medication efforts